Indicator: Pesticide Poisonings (276)

Even though pesticides play an important role in protecting human health, food, and crops, they pose a risk of poisoning when not used and stored properly. The American Association of Poison Control Centers (AAPCC) collects statistics on poisonings and represents the single largest source of information on acute health effects of pesticides resulting in symptoms and requiring health care (Calvert et al. 2001). The data include exposures to individual pesticides and to mixtures of products (about 8% of reports) where the primary cause (between two pesticides or between a pesticide and another product or products) could not be determined. The data also include intentional exposures (suicide attempts and malicious use) that account for less than 3% of reports. The AAPCC uses the Toxic Exposure Surveillance System (TESS) to collect information on all reported poison exposures.

This indicator is based on data from TESS published reports for the years 1986 through 2003 from (http://www.aapcc.org/poison1.htm). During this period at least 50% of the U.S. population was covered by Poison Control Centers (PCCs) reporting to the national database, and data were collected using the same definitions from one year to the next. Statistics are presented as known outcomes, meaning that the poison specialist followed up until an exposure could be classified as none (no symptoms reported), minor, moderate, major, or fatal. Poisonings were counted as cases with minor, moderate, major, or fatal outcomes. Annual observed figures were divided by the percent of U.S. population served to estimate the total poisonings nationwide, and divided by the total U.S. population to develop the incidence rate. Data are grouped into 3- year time periods and presented as average annual rates to facilitate looking for trends.

Counting only known outcome data may introduce some bias because the percent of all pesticide exposures with a known outcome declined from 71% in 1986-1988 to just 42% in 2001-2003. In order to determine whether the overall decline reported for all pesticides and functional subgroups is likely due to a real decline or due to an artifact of reporting, the indicator data are also presented for all exposures, whether symptomatic or not, and whether with known outcome or not.

What the Data Show

Between the periods1986-1988 and 2001-2003, there was an overall 24% decline in estimated exposures to pesticides and a 40% decline in poisonings reported in the United States (Figure 276-1, 276-2). The single largest decline occurred for organophosphate insecticides with a decline of 71% in poisonings and 64% in exposures. Organophosphate insecticides accounted for 24% of all poisonings from 1986 to 1988, but decreased to 11% of all poisonings from 2001 to 2003, a decline of 51%. Given that all poisonings have shown little change in trend, this decline is likely real and not an artifact of reporting bias.

As safer insecticides have been substituted for the organophosphates, there has not been a corresponding increase in poisoning among the replacements, which also declined in terms of poisonings (23%) and exposures (15%) over the period. Substantial declines in poisonings and exposures also occurred for fungicides (55% poisonings; 46% exposures) and disinfectants (51% poisoning; 42% exposures). Exposures have increased only for herbicides (10%), and rodenticides (1%), and poisonings have only increased for “other” pesticides, such as fumigants and repellents.

Indicator Limitations

- Misclassification may occur when symptoms are reported over the phone and are not confirmed by a physician or laboratory tests. About 13% of calls to PCCs arise from health care professionals, but the majority are calls made by victims or their relatives or caretakers. The PCC poison specialists must rely on their experience and judgment to determine which cases have symptoms consistent with the toxicology, dose, and timing of the exposure. Although some

misclassification can be expected to occur, it is assumed to be non-differential among the different types of pesticides. Declining follow-up of cases does effect the calculated decline in poisonings (which require follow-up to determine medical outcome), but this is not the case for exposures.

- Under-reporting of poisonings by doctors and hospitals to Poison Control Centers (PCCs) is a serious shortcoming. The range of referrals of poisonings from all substances from inpatient and outpatient cases to Poison Control Centers varies from 24 to 33%. (Chafee-Bahamon et al., 1983), (Harchelroad et al., 1990) (Veltri et al., 1987).

Data Sources

Poison Control Center Data, 1986-2003
http://www.aapcc.org/poison1.htm

References

Calvert GM, Barnett M, Blondell JM, Mehler LN, Sanderson WT. 2001. Surveillance of pesticide-related illness and injury in humans. Chapter in Handbook of Pesticide Toxicology, Second Edition, edited by R. Krieger, Academic Press, San Diego. p. 603-641

Chafee-Bahamon C, Caplan DL, Lovejoy FH. 1983. Patterns in hospital=s use of a regional Poison Information Center. American Journal of Public Health 73:396-400.

Harchelroad F, Clark RF, Dean B, Krenzelok EP. 1990. Treated vs. Reported toxic exposures: discrepancies between a Poison Control Center and a member hospital. Veterinary and Human Toxicology 32:156-159.

Veltri JC, McElwee NE, Schumacher MC. 1987. Interpretation and uses of data collected in Poison Control Centers in the United States. Medical Toxicology 2:389-397.

Graphics

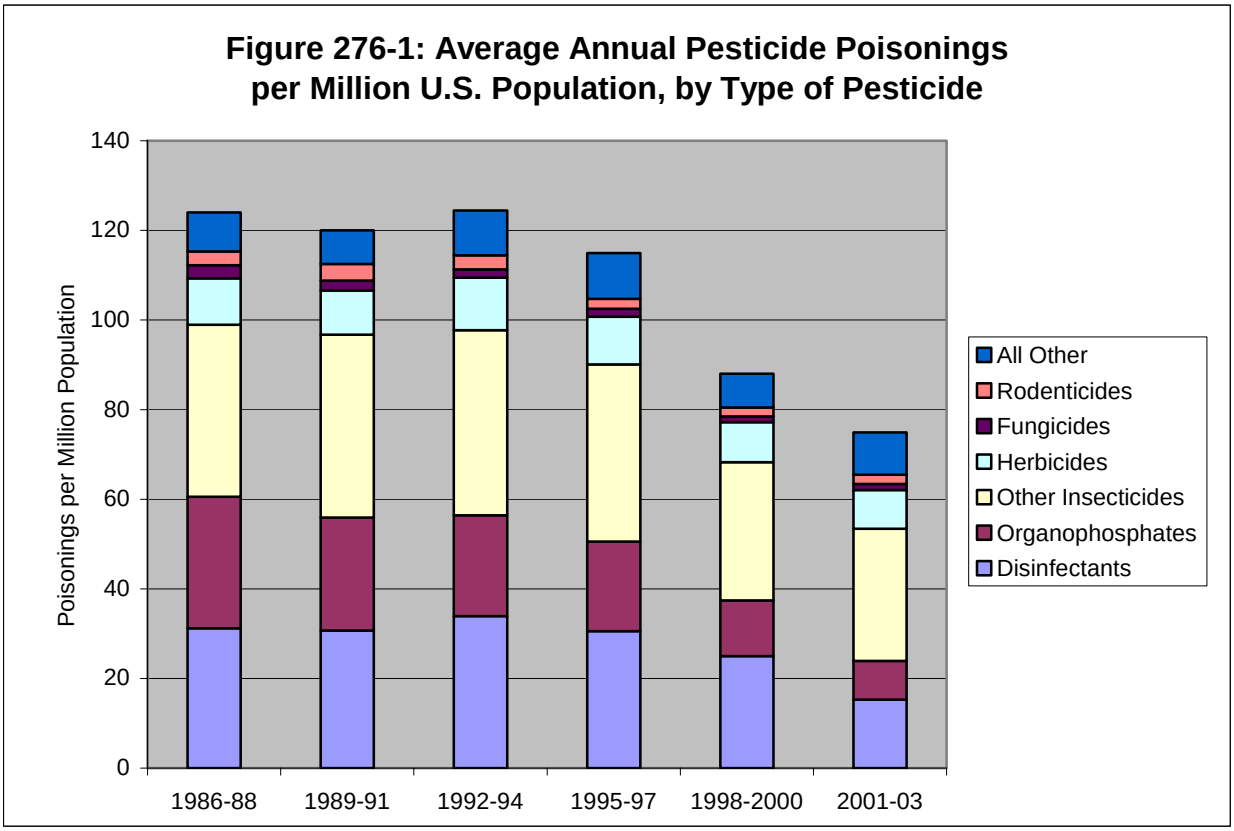
Figure 276-1: Average Annual Pesticide Poisonings per Million U.S. Population, by Type of Pesticide
Poisonings per Million Population
140
120
100
80
60
40
20
0
1986-88
1989-91
1992-94
1995-97
1998-2000
2001-03
All Other
Rodenticides
Fungicides
Herbicides
Other Insecticides
Organophosphates
Disinfectants

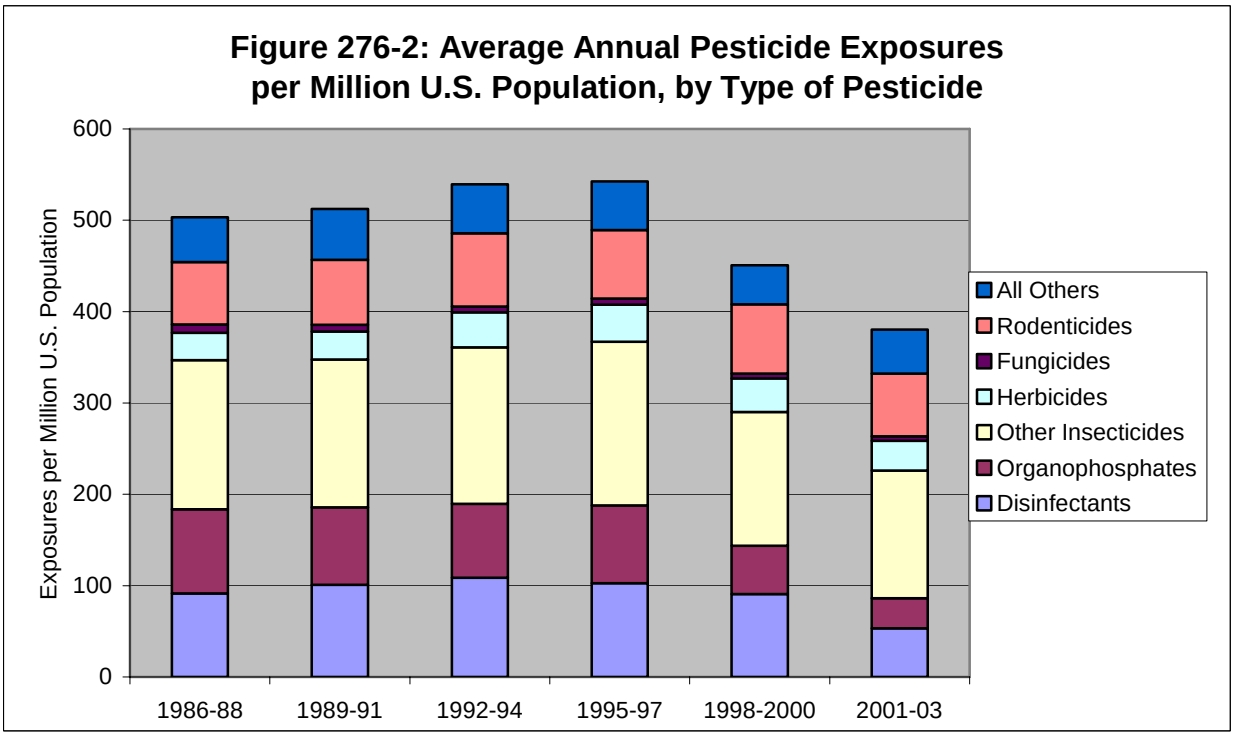
Figure 276-2: Average Annual Pesticide Exposures per Million U.S. Population, by Type of Pesticide
Exposures per Million U.S. Population
600
500
400
300
200
100
0
1986-88
1989-91
1992-94
1995-97
1998-2000
2001-03
All Others
Rodenticides
Fungicides
Herbicides
Other Insecticides
Organophosphates
Disinfectants

R.O.E. Indicator QA/QC

Data Set Name: PESTICIDE POISONINGS
Indicator Number: 276 (89085)
Data Set Source:
Data Collection Date: 1986-2003
Data Collection Frequency: 1 yr
Data Set Description: Pesticide Poisonings
Primary ROE Question: What are the trends in chemicals used on the land and their effects on human health and the environment?(Chemicals to include toxic substances, pesticides, fertilizers, etc.)

Question/Response

T1Q1 Are the physical, chemical, or biological measurements upon which this indicator is based widely accepted as scientifically and technically valid?

There are no physical, chemical, or biological measurements for this indicator. It is based on incidence data reported by poison control centers.

T1Q2 Is the sampling design and/or monitoring plan used to collect the data over time and space based on sound scientific principles?

There is no sampling plan or monitoring plan similar to that used in laboratory studies. Poison Control Centers collect information on each call according to standardized definitions for each data element collected. Some 60-65 Centers staffed by six or more personnel each are responsible for collection of the information on each case, properly coding the information and submitting it to the AAPCC that maintains the national database. Reporting by individual PCCs is dependent on how well their service is known and advertised. The standardized form or computer record that is used must contain all data elements filled out and sufficient narrative to permit peer review and medical or legal audit. The data must be submitted to the AAPCC's Toxic Exposure Surveillance System within deadlines and meet quality requirements as specified in guidance of the AAPCC.

T1Q3 Is the conceptual model used to transform these measurements into an indicator widely accepted as a scientifically sound representation of the phenomenon it indicates?

The observations collected are presented along with the denominator population served and the total population of the United States. This permits calculating the incident rate which is the number of illnesses (poisonings) in a given year per million population in the United States. The incident rate is the primary measure of hazard used in epidemiology and surveillance studies.

T2Q1 To what extent is the indicator sampling design and monitoring plan appropriate for answering the relevant question in the ROE?

The indicator in this case collects all observations (a census) rather than employing a sampling strategy. Given the widespread coverage of the US population, the data are appropriate for national estimates, but not regional ones. One limitation is that fewer states are covered in earlier years. An average of 62% of the US population was covered from 1986-90, 80% for 1991-96, and 97% for 1997-2003.

T2Q2 To what extent does the sampling design represent sensitive populations or ecosystems?

The indicator collects reports from all of the population served, but does not actively seek out reports from sensitive populations. Nevertheless, it is possible to examine the data for differences due to age, sex and pregnancy status that can identify particular susceptibilities in subgroups of interest.

T2Q3 Are there established reference points, thresholds or ranges of values for this indicator that unambiguously reflect the state of the environment?

Reference points, thresholds and range of values do not apply to this indicator in the same manner it would for laboratory-type measurements.

T3Q1 What documentation clearly and completely describes the underlying sampling and analytical procedures used?

The use of a standard format by different Poison Centers with standard definitions for each data element means that studies can be done using two or more centers (Veltri et al. 1987). Each Center follows a coding manual that documents the procedures for documenting each call and the definitions of all the data elements. Instructions for the American Association of Poison Control Centers Toxic Exposure Surveillance System, 2001. unpublished, but may be available to APCC members at http://www.aapcc.org.

T3Q2 Is the complete data set accessible, including metadata, data-dictionaries and embedded definitions or are there confidentiality issues that may limit accessibility to the complete data set?

The data set is proprietary because it is sold by a non-governmental organization to the EPA under the condition that only summaries of the data may be shared outside of EPA. The summaries are not confidential but the raw data on individual cases is considered confidential. Medical confidentiality would apply for individual cases that could be traced back to a particular health care provider and but summary information for several cases has no such concern.

T3Q3 Are the descriptions of the study or survey design clear, complete and sufficient to enable the study or survey to be reproduced?

Descriptions of the procedures followed by each participating Poison Control Centers are written and include: " Have a board certified physician on-call at all times with expertise

in medical toxicology. " Have poison specialists available to handle all calls. These specialists are required to complete a training program and are certified by the AAPCC. " Maintain a comprehensive file of toxicology information sources and have ready access to a major medical library. " Maintain operational guidelines which provide a consistent approach to evaluation and management of toxic exposures. " Have an ongoing quality assurance program including regularly scheduled conferences, case reviews and audits. " Keep records on all cases handled by the Center with data elements and sufficient narrative to allow for peer review. " Submit all case data to the Toxic Exposure Surveillance System, meet deadlines and quality requirements and include all required data elements. Taken together all these criteria help assure the quality of the data.

T3Q4 To what extent are the procedures for quality assurance and quality control of the data documented and accessible?

Not all procedures for quality assurance have been provided in detail, but there has been an audit at EPA s request. The AAPCC conducted an audit of 588 randomly-selected pesticide charts based on records submitted to the TESS in 1996. Thirty-four cases were excluded from a Center that was over-represented in the data set and another 24 cases were excluded because of three Centers that had closed since 1996. After these exclusions, requests for 530 cases were sent to the PCCs and 512 records were located and returned to the AAPCC for a response rate of 96.6%. Thirteen records could not be located, one Center did not send the three requested records, and the wrong record was sent in two cases. Cases were reviewed to determine how accurately the information coded in TESS matched the information in the original medical record. Five fields important to this analysis were selected for the audit: reason for exposure, route of exposure, management site of case, medical outcome, and accuracy of specific and generic substance category. Results from the audit found the majority of cases were coded correctly (AAPCC Audit of 1996 AAPCC TESS Human Exposures to Pesticides for EPA. American Association of Poison Control Centers, Washington, DC 1998). Of those cases that did contain errors, the most common error was insufficient follow-up to accurately code the flow of patient care or medical outcome. Reason for exposure was coded correctly 90.4% of the time, incorrectly coded in 4.5%, and insufficient information to determine coding in 5.1%. Route of exposure was coded correctly in 95.9% of cases and incorrectly coded in 3.7% (1.7% incorrect route and 2.0% route(s) omitted). Health care facility use and referral was correctly coded for 93.5%, incorrect in 1.8%, and unable to determine correct coding in 4.7%. Outcome was correctly coded in 82.8%, coded incorrectly in 5.1%, and unable to determine correct coding in 12.1% (due to inadequate follow-up or missing information). Substance was correctly coded 93.3% of the time, incorrectly coded 6.5%, and unable to determine if correct 0.2%. Generic code was coded correctly 98.1% of the time and incorrectly coded 1.7% of the time.

T4Q1 Have appropriate statistical methods been used to generalize or portray data beyond the time or spatial locations where measurements were made (e.g., statistical survey inference, no generalization is possible)?

Data collected are a census of all calls received by participating Poison Control Centers. Appropriate methods are used to determine catchment areas served by Poison Centers so that the population served can be determined. Based on the proportion population served compared to the US population, national estimates may be generated.

T4Q2 Are uncertainty measurements or estimates available for the indicator and/or the underlying data set?

The analyses performed involve the calculation of rates based on total US population and simply comparing the earlier and later time period for trends. These calculations are not subject to variability or uncertainty in the usual statistical sense.

T4Q3 Do the uncertainty and variability impact the conclusions that can be inferred from the data and the utility of the indicator?

Counts rather than measurements are the primary data collected, therefore uncertainty and variability are not an important concern, except as described above.

T4Q4 Are there limitations, or gaps in the data that may mislead a user about fundamental trends in the indicator over space or time period for which data are available?

There are important limitations that can lead to misinterpretation of trends. Nearly half of the reported exposures received successful follow-up to determine medical outcome. These are the reports that can be classified as adverse effects or poisonings if signs or symptoms occur. The percentage of cases with outcome determined has declined from 71% during the early years (1986-88) to 42% in the later years (2001-3). One method of determining whether the decline is an artifact of decreased follow-up is to determine whether all exposures have declined. Misclassification may occur when symptoms are reported over the phone and are not confirmed by a physician or laboratory tests. About 13% of calls to PCCs arise from health care professionals, but the majority are calls made by victims or their relatives or caretakers. The PCC poison specialists must rely on their experience and judgment to determine which cases have symptoms consistent with the toxicology, dose, and timing of the exposure. Although some misclassification can be expected to occur, it is assumed to be non-differential among the different types of pesticides. Under-reporting of poisonings by doctors and hospitals to Poison Control Centers (PCCs) is a serious shortcoming. The range of referrals of poisonings from all substances from inpatient and outpatient cases to Poison Control Centers varies from 24 to 33%. A study by Chafee-Bahamon et al. (1983) found that of 19,544 inpatient or outpatient cases seen in Massachusetts in 1979, 24% were referred to the State s Poison Control Center. A one-year retrospective study in an urban hospital in Pennsylvania identified 470 toxic exposures of which 123 (26%) were referred to the local Poison Control Center in 1988 (Harchelroad et al. 1990). A much earlier report (Veltri et al. 1981) looking at inpatient and outpatient cases in Utah found that Poison Centers captured about a third of these cases.